The 8th Meeting of Japan CF-Research Society

JCF8 ABSTRACTS

November 29-30, 2007

Doshisha University

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Program of JCF8 Meeting

(Japan CF-Research Society)

Date and Place: November 29-30, 2007, at Kanbai-kan, Muromachi Campus,
Doshisha University, Kyoto, Japan

Paper presentation: oral presentation 20 min. + discussion 5 min.,
Language= English or Japanese

Book of Abstract: only available at JCF home page
http://dragon.elc.iwate-u.ac.jp/jcf/index.html

November 29, (Thur.), 2007

9:00-9:50 **Registration**

9:50-10:00 **Opening Address** (E. Yamaguchi, Doshisha U.)

Theory-1 (chairman: H. Numata, Tokyo Institute of Tech.)

10:00-10:25 **JCF8-1** H. Yamamoto: An explanation of earthquake lightning by cold fusion

10:25-10:50 **JCF8-2** S. Sasabe et al. (Tokyo Metropolitan U.): Change of Coulomb potential of electron due to band structure in semiconductor

10:50-11:15 **JCF8-3** T. Sawada (RIMM): How the process change from d+d→t+p (and ^{3}He+n) to d+d→^{4}He

11:15-11:40 **JCF8-4** T. Sawada (RIMM): Calculation of the bound states of the magnetic monopole and the small nucleus system

-----**lunch** (11:40-13:00)-----

Experiment-1 (chairman: A. Kitamura, Kobe U.)

13:00-13:25 **JCF8-5** J. S. Gao et al. (Toyota Central R & D Labs): Influence of sulfur and surface morphology on D_2 permeation through Pd membrane

13:25-13:50 **JCF8-6** K. Tsuchiya et al. (Tokyo N. C. T.): A new approach to observe optical phonon in hydrogen storage Pd using Raman spectroscopy. I

13:50-14:15 **JCF8-7** S. Asano et al. (Tokyo N. C. T.): A new approach to observe optical phonon in hydrogen storage Pd using Raman spectroscopy. II

14:15-14:40 **JCF8-8** S. Narita et al. (Iwate U.): Investigation of nuclear phenomena in deuterium diffusion from Pd heterostructure

-----**break** (20 min)-----

Invited Papers (chairman: A. Takahashi, Osaka U.)

15:00-16:15 **JCF8-9** Y. Arata (Osaka U.): Towards the establishment of new energy production

16:15-16:40 **JCF8-10** A. Kishida et al. (U. of Hyogo): In-situ measurement and micro-beam analysis of nuclear transmutation reaction induced by D_2 gas permeation through Pd complexes by X-ray fluorescence spectrometry.

16:40-18:00 **JCF Annual Meeting**

18:00-21:00 **Reception**

November 30, (Fri.), 2007

Theory-2 (chairman: T. Sawada, RIMM)

10:00-10:25 **JCF8-11** M. Fukuhara (Tohoku U.): Approach to cold nuclear transformation

10:25-10:50 **JCF8-12** H. Kozima (CF Res. Lab.): An explanation of nuclear transmutation in XLPE (Crosslinked Polyethylene) films with and without Water Trees

10:50-11:30 **JCF8-13** A. Takahashi (Osaka U.): Chronicle of condensed cluster fusion models

-----**lunch** (11:30-13:00)-----

Experiment-2 (chairman: E. Yamaguchi, Doshisha U.)

13:00-13:25 **JCF8-14** T. Jang et al. (Yokohama National U.): Gas and heat balancing during plasma electrolysis

13:25-13:50 **JCF8-15** T. Yamaguchi et al. (Kobe U.): Investigation of nuclear transmutation in $(CaO/Sr/Pd)_n/CaO/Sr/Pd$ samples

13:50-14:15 **JCF8-16** Y. Toriyabe et al. (Tohoku U.): Radiation measurement during gas permeation experiment

14:15-14:40 **JCF8-17** H. Yamada et al. (Iwate U.): Producing elements of mass number 137 and 141 by deuterium permeation on multi-layered Pd samples with Cs deposition

-----**break** (20 min)-----

Theory-3 (chairman: S. Sasabe, Tokyo Metropolitan U.)

15:00-15:25 **JCF8-18** M. Ozaki (Tokyo U. of Agriculture): Effect of the energy level of a hydrogen atom due to magnetic moment interaction

15:25-15:50 **JCF8-19** H. Numata et al. (Tokyo Institute Tech.): Numerical simulation of vortex pattern appeared on electrode surface after long term electrolysis of well annealed thick Pd rod in 0.1 M LiOD

15:50-16:15 **JCF8-20** M. Ban et al. (Tokyo Metro. Leather Tech. Center): Evolution of co-operative tunnel resonance in canonical ensemble system

16:15-16:40 **JCF8-21** N. Yabuuchi (High Sci. Res. Lab.): The Pythagorean theorem and nuclear fusion in Platonic structures

16:40-17:20 **JCF8-22** H. Kozima (CF Res. Lab.): The cold fusion phenomenon as a complexity (2) – Parameters characterizing the system where occurs the CFP –

JCF8-23 H. Kozima (CF Res. Lab.): The cold fusion phenomenon as a complexity (3) – Characteristics of the complexity in the CFP –

Adjourn

An Explanation of Earthquake Lightning by Cold Fusion

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Key words: atomic hydrogen, hydrogen fusion, gamma ray, neutrinos. earthquake lightning

Introduction

The mechanism of earthquakes is currently explained by the plate-tectonics theory which claims the earth's surface is covered with a series of crustal plates that can store elastic energy caused by relative movement of each plate. But recent observations of slow slips of crustal plates by GPS (Global Positioning System) dismiss this idea and a new idea called asperity was created. The recent deployment of many seismometers and occurrences of earthquakes in Japan revealed explosive nature of earthquakes. There have been reports that earthquakes and earthquake lightning took place simultaneously, but there has been no plausible hypothesis to correlate each other.

Helium gas eruption accompanied with earthquakes

It is known that water injection into deep wells can cause earthquakes. The Matsushiro swarm earthquakes gave us information on relations between water and helium gas eruption in the event of earthquakes(1). Steven E. Jones hypothesized that the anomaly of helium-3 found in the gasses escaping from volcanoes was made in the Earth's interior by hydrogen fusion.

Fusion of hydrogen dissociated from water under the ground

Recently, R.L. Mills has reported that atomic hydrogen can generate energy somewhat between chemical reaction and nuclear reaction by lowering the electron orbit from the ground state to lower state(2). According to Mills, hydrogen atoms can achieve lower states than ground state by a resonant collision with a nearby atom or combination of atoms having the capability to absorb the energy to effect the transition, namely, an integer multiple of the potential energy of the electron at atomic hydrogen, m*27.2 eV (m is an integer) . He named this shrunken hydrogen atom hydrino and claims that this hydrino can be a catalyst to shrink other hydrinos to further lower states. He named this reaction the BlackLight Process.

It is known that water injection into deep wells can cause earthquakes.

The Earth's crust is divided into several separate solid plates. Subduction occurs when two plates collide and the edge of one dives beneath the other. The crust contains water and when it contacts with hot magma, metals in magma such as iron produce atomic hydrogen according to the following reaction.

$3Fe + 4H_2O = 8H + Fe_3O_4$, where H designates atomic hydrogen.

Once atomic hydrogen is produced and if there is no heat sink at the collision point, just a collision of atomic hydrogen for instance, $H + H = H_2$ (molecular hydrogen) wouldn't take place but just elastically repulse each other. This suggests that high pressure atomic hydrogen gas will build up under the ground. As is shown below, a simultaneous collision of 3 atomic hydrogen is the BlackLight Process because the ionization energy of hydrogen is 13.6eV and the sum of the ionization energy of 2 hydrogen is 27.2eV.

H + H + H = [Hn=1/2] + 2 p+ 2 e

p designates proton and [Hn=1/2] designates a hydrogen whose electron orbit is shrunken to 1/2 the radius of a normal one and these will be shrunken further to lower orbits as reaction continues. It can be postulated that if containing vessels are tight enough as is the case of the underground, well shrunken hydrinos which have a relatively small Coulomb barrier can fuse each other(3).

Earthquake lightning by neutrino flux accompanied by hydrogen fusion under the ground

The first step of the fusion by hydrogen is :

p + p = d + positron + electron neutrino, where d designates deuteron.

Positron will recombine with electron, emitting gamma ray (0.511MeV) which may not be transmitted to the surface through the cracks made by earthquakes, but electron neutrinos can penetrate the crust. Electron neutrinos have very little capability to interact with matters but it can be reasonably postulated that huge neutrino flux generated by M7 class earthquakes (equivalent to one mega-ton class hydrogen bombs) can energize gas molecules in the atmosphere, resulting in generation of lightning or luminescence. Luminescence by neutrinos is utilized to study the characteristics of neutrinos in research laboratories and is a well known phenomenon.

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Change of Coulomb Potential of Electron due to Band Structure in Semiconductor

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Ken-ichi Tsuchiya **) **(Tokyo National College of Technology)**
Kyo-ta Watanabe **(Tokyo Metropolitan University)**

The quantization of Lorentz-Dirac equation leads us to a strange Coulomb potential between two charged particles: That has some critical length R_c, and the ratio of that potential and the original Coulomb potential decreases rapidly inside the distance smaller than critical length R_c.
The form of that potential is [1]

$$U(r) = \frac{e^2}{r}\left[1 - \exp\left(\frac{-r}{2R_c}\right)\cos\left(\frac{r}{2R_c}\right)\right]. \qquad (1)$$

In vacuum, the critical lengths are $R_c = 1.9\times 10^{-12}$ cm for electron, $R_c = 1.0\times 10^{-15}$ cm for proton, respectively. These values are too small to achieve some effects in vacuum. However, there exists the possibility that these critical lengths change drastically in materials, because these depend on the mass of electron and the speed of light. Light speed reduction in material is well known. The electron mass is also replaced by effective mass in material such as semiconductor. Recently, Zawadzki[2] pointed out that the quantities of the relativistic electron in vacuum must be changed in semiconductor. Roughly speaking, for example, the Compton wave length of electron changes from 10^{-11}cm in vacuum to $10\,\mathring{A}$ in semiconductor. Possible change of the electron spin-magnetic moment in semiconductor is also implied by the present authors[3].

Then it is strongly expected that the critical length R_c in Eq.(1) for deuteron becomes large enough, if deuterons have some band structure in palladium like the electrons in semiconductor. Large R_c for deuteron facilitates the understanding of the cold fusion by the use of Eq.(1).

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How the process changes from $d + d \rightarrow t + p$ (and $^3He + n$) to $d + d \rightarrow ^4 He$

Tetsuo Sawada (RIMM)

In the low energy limit of the d+d reaction in vacuum, it is well-known that the final states $t + p$ and $^3He + n$ occur with nearly the same probability, and $^4He + \gamma$ occurs with very small branching ratio. These experimental facts are understood well simply by the energy and the momentum conservations plus the isotopic invariance. In general, "two body $\rightarrow$ one body" reaction such as $d + d \rightarrow ^4$He is forbidden, because the two consevation laws are not compatible when the energy production Q of the reaction is positive. We may recognize the incompatibility in the following way: if we see the reaction in the center of the mass system, the momentum $\vec{q}$ of the particle of the final state must be zero from the momentum conservation. On the other hand, the energy conservation requires $Q = q^2/2M_f$, where M_f is the mass of the final particle, and q^2 cannot be zero. Therefore this process cannot proceed in vacuum.

However we know in the problem of the potential scattering that the amplitude $f(\vec{q})$ of the momentum transfer $\vec{q}$ is the Fourier transformation of the potential:

$$f(\vec{q}) = -(2m/4\pi\hbar^2) \int V(r') \exp[i\vec{q} \cdot \vec{r'}] d^3r'$$

, and the probability of the momentum transfer is $|f|^2$. Therefor if the reaction proceeds under the influence of the external potential, which can absorbe the momentum, the reaction such as $d + d \rightarrow ^4 He$ is not forbidden. In particular for the case of the ^{4}He production, since $Q = 23.9$MeV. and $M_f c^2 = 3727$MeV., the momentum transfer becomes $cq = 422$MeV., and which correspond to $\Delta r = 0.47$fm. estimated from the uncertainty relation. Therefore the size or spead of the required external potential $V(r)$ must be fm.-size, in order to do the job to receive such large momentum $\vec{q}$.

In this way, the change of the process gives us the important information concerning the underlying mechamism of the nuclear cold fusion. There is another important source of the information. The lack of the reproducibility of the cold fusion is regarded as something "embarrassing", however it can supply us important information on the underlying mechanism.

Calculation of the bound states of the magnetic monopole and the small nucleus system

Tetsuo Sawada (RIMM)

It is well-known that the magnetic monopole accompanies the super-strong magnetic Coulomb field, and the magnetic couterpart of the "fine structure constant" is as large as ${}^{*}e^2/\hbar c = 137D^2/4$ in which D=1 and D=2 for Dirac and Schwinger monopole respectively. The nucleons have the small magnetic moments $\kappa_{tot}(e/2m)\vec{\sigma}$ where m is the proton mass and $\vec{\sigma}$ is Pauli matrices of the nucleons, and κ_{tot} =2.8 and -1.9 respectively for proton and neutron. Therefore the hamiltonian of the nucleon in the magnetic Coulomb field produced by a monopole fixed at the origin becomes

$$H_{m-N} = (1/2M)(-i\hbar\vec{\nabla} - Ze\vec{A})^2 - \kappa_{tot}(D/4m)(\hat{r}\cdot\vec{\sigma}/r^2)F(r)$$

, in which the charge quantization condition ${}^{*}ee = D/2$ is used. F(r) comes from the nucleon form factor and its form is

$$F(r) = 1 - (1 + ar + a^2r^2/2)\exp[-ar] \qquad with \quad a = 6.04\mu_\pi .$$

The vector potential $\vec{A}$ must be chosen in such a way that its rotation becomes the magnetic Coulomb field: $\vec{\nabla} \times \vec{A} ={}^{*} e\hat{r}/r^2$. In the hamiltonian, Z=1 and 0 for the proton and the neutron respectively.

It is straightforward to extend the above 1-nucleon hamiltonian to the A-nucleon hamiltonian H_A:

$$H_A = \sum_i H^{(i)}_{m-N} + \sum_{i>j} V_{i,j}$$

, where $V_{i,j}$ is the known nuclear potential between i-th and j-th nucleons. Once the hamiltonian is known, from the quantum theory we can determine the ground state and can trace the time development of wave function by solving the time dependent Schrödinger equation $i\hbar\partial_t\Psi = H_A\Psi$. For A=1 we can solve the equation exactly. However for larger A, the simulation of the equation is inevitable, and the necessary computing time increases rapidly with A. So we shall consider only the small nuclear system: $A \le 4$. Even in such a small system, we can expect to see the novel feature of the monopole and nuclear system. For example, in the zero incident energy reaction of $d+d \rightarrow {}^4$He, the fixed magnetic monopole starts to gather the surrounding deuterons and to form the bound state, in which the direction of the magnetic moment of the deuteron orients outward. When two deuterons are trapped, they fuse to become tightly bound nucleus ^{4}He by flipping the spin, which is caused by the spin-flip term of the nuclear potential. Since the spin-0 charged particle such as ^{4}He cannot form the bound state with the monopole, the α-particle is emitted and there remains a fresh monopole and it again gather the deuterons. In this way the cycle of the nuclear fusion reaction closes. The extension of the nuclear physics to include the magnetic monopole as an additional ingredient is fruitful, since it can serve to convince the nuclear physicists of the reality of the nuclear cold fusion theoretically.

Influence of Sulfur and Surface Morphology on D_2 Permeation through Pd Membrane

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Nuclear transmutation in flowing deuterium gas system with CaO/Pd multiplayer structure has firstly been reported in 2002 by Iwamura et al. [1] So far a few experiments have been reported to confirm such nuclear transmutation.[2-5] From Iwamura's report, the transmutation rate increased with increasing deuterium flow rate.[6] Thus, it is necessary to obtain a high deuterium flow rate during permeation. In our trial to reproduce the nuclear transmutation of Iwamura group, we have found that D flow rate was low in the permeation, and it became much lower after 80 hours from the beginning of the permeations. Therefore, the purpose of this work is to clarify the reason of our low deuterium permeation rate, and we focus on the influence of Pd morphology and sulfur to the deuterium permeation.

It was found that when S concentration on Pd membrane was high before the permeation, the permeation rate was low. Meanwhile, if S concentration increased after permeation, the gas flow rate decreased quickly during permeation. [7] Deuterium permeation rate decreased because a layer of sulfur segregated on the surface from the inner part of the Pd foil and hindered the dissociative adsorption of D_2 by blocking dissociation sites. [7, 8] It was also confirmed that rough surface of Pd membrane was better than the smooth one to get high deuterium permeation rate. Since deuterium requires dissociative adsorption of deuterium molecules on Pd surface at the first step, rougher surfaces possessing a larger area of adsorption are advantageous to high permeation. Based on the analyses on the cause of the low deuterium permeation in our experiment mentioned above, we improved the preparation process of the Pd foil and developed a method to keep permeation rate at high level for a long period.

References

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A new approach to observe optical phonon in hydrogen storage Pd using Raman spectroscopy. I

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Abstract

In solid state physics, it is well known that pure Pd lattices only have acoustic mode lattice vibrations, because it forms perfect fcc structure. However, hydrogen–hydrogen interactions in Pd induce optical mode lattice vibrations [1]. This means that optical phonon in hydrogen storage Pd can be observed by using Raman spectroscopy. In this study, we have tried it in order to investigate the nuclear reactions in Pd.

This measurement can be done for the sample completely sealed in a glass tube cutting off the influence of the external air, because glass materials are Raman inactive. In the measurement chamber of spectroscopy device, scattered waves of the incident laser beam from the hydrogen storage Pd are detected and Raman shifts including the information about the optical phonon in the sample are derived.

The standard scanning time for this measurement is 15 minute. So we can easily observe the change of phonon states proceeding with time by repetitive measurements. In this repetition, the large changes in Raman spectra may inform us the effects from the condensed states of hydrogen [2] and nuclear reactions in Pd.

In part Ⅰ, the principles of the measurements are described in brief. In part Ⅱ, elementary results are discussed.

References

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A new approach to observe optical phonon in hydrogen storage Pd using Raman spectroscopy. Ⅱ

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Abstract

The purpose of this study is to observe the lattice vibration of PdHx and PdDx and obtain the information about the quantum states of protons and deuterons in Pd using Raman spectroscopy.

Results for the Raman spectra of PdHx and PdDx at room temperature are plotted in Fig.1 and Fig.2. Seeing both of them, broad peaks induced by the interactions between protons or deuterons in Pd exist at 56 meV for every concentration. Sharp peaks are regarded as the influence from some noises. The isotope effects were not observed.

In near future, we will try to have repetitive measurements and investigate the change of phonon states proceeding with time. In these measurements, the nuclear reactions may be detected as large changes of phonon states.

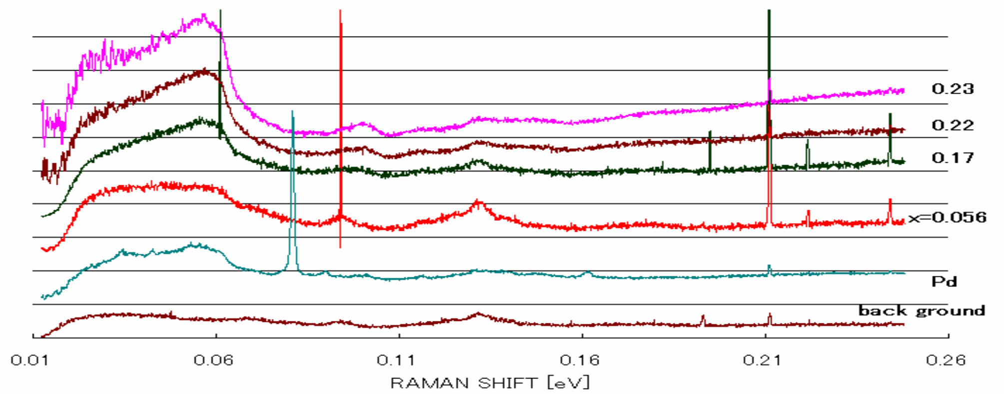

Fig.1 Raman spectra of PdHx.

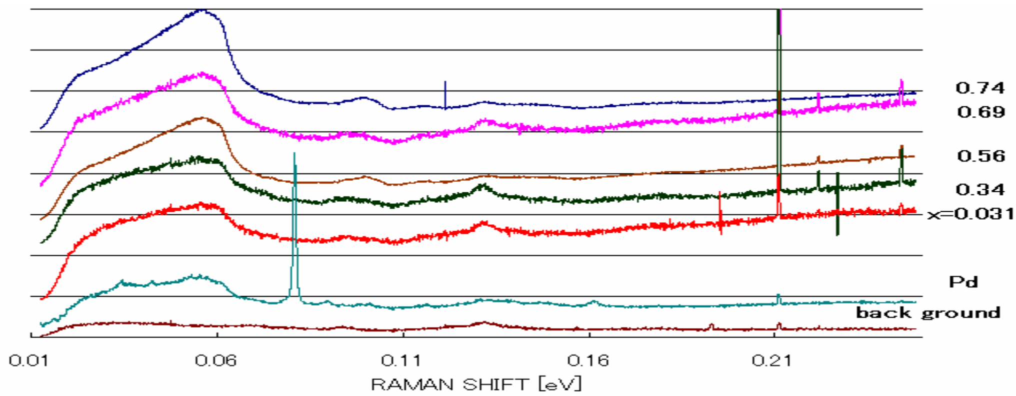

Fig.2 Raman spectra of PdDx.

Investigation of nuclear phenomena in deuterium diffusion from Pd heterostructure

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It has been known that nano-size Pd cluster is capable of absorbing hydrogen effectively, rather than the bulk Pd [1,2]. Such property of fine Pd cluster is possibly connected with the trigger condition of low energy nuclear reaction (LENR) in condensed matter. For instance, Arata proved helium production in deuterium absorption process to nano-particle Pd [3]. On the other hand, Iwamura has reported that the selective transmutation occurs in permeation of D through thin-layered Pd/CaO complex [4]. Yamaguchi observed excess heat and helium production in controlled deuterium diffusion from the heterostructure Au/Pd/MnO sample [5]. Lipson also reported charged particle emissions in deuterium diffusion from Pd/PdO sample [6]. In these experiments, the fine structure of the sample, *i.e.* nano-size Pd or multi-layered Pd complexes, is thought to play an important role for inducing LENR.

Considering the experimental results mentioned above, we performed the deuterium absorption and diffusion experiment using Pd/Au, Pd/CaO and Au/Pd/CaO. These samples were prepared by depositing thin Au or CaO layer onto 0.5 mm thick Pd substrate. The sample was exposed to 10 atm deuterium gas for 23 hours in the chamber, and loaded with deuterons. After loading, it was set into the chamber which can be evacuated to 10^{-5} Pa and applied the DC current to stimulate the deuterium diffusion. The surface temperature of the sample, the inside pressure of the chamber, and the electric current and the voltage were monitored in the diffusion process. The CR-39 track detector was used to detect nuclear emission. In this paper, we report characteristics of the deuterium absorption and diffusion processes followed by nuclear phenomena for each sample type.

References

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In-situ measurement and micro-beam analysis of nuclear transmutation reaction induced by D_2 gas permeation through Pd complexes by X-ray fluorescence spectrometry

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Observations of nuclear transmutation reactions induced by D_2 gas permeation through Pd complexes (Pd/CaO/Pd) have been already reported [1]. When Cs was added on the surface of a Pd complex, Pr emerged on the surface while Cs decreased after the Pd complexes was subjected to D_2 gas permeation. When Sr was added to the surface, Mo emerged while the Sr decreased after D_2 gas permeation. The isotopic composition of the detected Mo was different from the natural abundance. Generally, nuclear reactions require the energy higher than the Coulomb barrier of nuclear interactions. However, this phenomenon occurs without additional high energy and it may bring great scientific impact.

We have been studying this phenomenon using X-ray Fluorescence Spectrometry (XRF) at SPring-8, a large synchrotron radiation facility [2-3]. *In-situ* measurement of transmutation of Cs into Pr was performed, and using small size X-ray beam, the surface distribution of Pr was investigated. Experimental results showed that the density of Pr on the Pd surface was not uniform. Furthermore, unidentified peaks near 4.5keV were found in some XRF spectra. To distinguish the unidentified peak, we investigated the X-ray energy dependence of the XRF, and the unidentified peak was assigned to Ti.

[Acknowledgments] The above results have been obtained by the collaboration work with Dr. Yasuhiro Iwamura, Takehiko Itoh and Noriko Yamazaki, Mitsubishi Heavy Industries, ltd.
XRF experiments in this work were performed at the BL37XU in the SPring-8 with the approval of the Japan Synchrotron Radiation Research Institute (JASRI) (Grant No. 2004B0456-NXb-np, 2005A0250-NXb-np, 2005A0409-NXb-np-Na, 2005B0554, 2006A0241, 2007A1518).

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Approach to cold nuclear transformation [1]

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Abstract

The cold transmutation observed on the surfaces of Sr- or Cs-doped Pd/(CaO+Pd)Pd complexes [2] is interpreted to be a result of virtual ${}^{8}_{4}X$ particle addition by the confinement of four interstitial solute deuterons jumping from four tetragonal sites to octahedral ones sites along [111] directions in a Pd/CaO lattice and electrostatic attraction due to the charge transfer in the chains of atoms; *i.e.*, an alternating tetrahedral-octahedral site arrays with the aid of the electron-phonon charge-density wave coupling and electropionic attraction effects due to the capture of excited electrons from Pd and Ca by vacuum pumping:

$${}^{88}_{38}Sr + 4\,{}^{2}_{1}D + 8\,e^{*} \rightarrow {}^{96}_{42}Mo$$

$${}^{133}_{55}Cs + 4\,{}^{2}_{1}D + 8\,e^{*} \rightarrow {}^{141}_{59}Pr.$$

The deuterons are a source of supply for reparation for mass balance in the transmutation. The roles of CaO are dissolution of Sr and Cs and the creation of a good route for deuteron rushing. We have reported the electron and the neutrino in a nucleus enhance the fusion reaction [3] as well as the catalytic effect of neutral pions for formation of nitrogen in Earth [4].

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JCF8-12

An Explanation of Nuclear Transmutation in XLPE (Crosslinked Polyethylene) Films with and without Water Trees (Abstract)

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An explanation of the nuclear transmutation observed in the XLPE (closslinked polyethylene) films by Kumazawa et al.[1] was presented based on the neutron-drop model used in the theoretical investigation of the cold fusion phenomenon [2]. Experimental results have clearly shown that nuclear transmutations have occurred when there are water trees in XLPE films over a metal substrate applied high-frequency (2.4 – 3.0 kHz), high-voltage (3.0 – 4.0 kV/mm) electric fields.

According to the theoretical investigation given before [2], there is formed a neutron band below zero (neutron evaporation level) when lattice nuclei (C in the XLPE case) couples with protons/deuterons (protons in this case). The neutrons in the band result in neutron drops $^{A}_{Z}\Delta$ composed of Z protons, Z electrons and $(A - Z)$ neutrons. The neutron drops interact strongly with impurity nuclei or disordered nuclei at boundary to induce nuclear reactions in solids that are different from those in free space. The nuclear reactions in solids thus induced are characterized by several properties; (1) liberated energy in the nuclear reactions are transferred to the crystal lattice not emitted as gamma rays, (2) the threshold energy for nuclear reactions in free space becomes zero or very low, (3) the threshold energy for fission also becomes zero or very low. The weak radiation observed by Kumazawa et al. [3] is considered as a proof of the occurrence of nuclear reactions in the system where the water trees are formed but is an incidental effect accompanied to main nuclear reactions triggering the formation of water trees in the XLPE samples.

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Chronicle of Condensed Cluster Fusion Models

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We have studied the theoretical models of deuteron-cluster fusion in dynamic process under the ordering/constraint conditions in regular metal-deuterium lattice, on complex surface of metal-deuterium interaction and/or along interface of metal-oxide layer for 18 years since 1989, and have recently shown[1,2] that the tetrahedral symmetric condensate (4D (or H)/TSC) will make ultimate condensation to TSC-min state with 10-20 fm diameter to induce almost 100% 4D fusion per TSC generation[3,4,5], based on the non-linear Langevin equation with quantum-mechanical ensemble averaging to use equations for expectation values.

In this paper, we review our recent works for derivation of Langevin equations for nD-cluster systems (n=1-6) under Platonic symmetry and show obtained deuteron-trapping potentials, ground states of clusters, time-dependent d-d distances, particle kinetic energies, barrier penetration factors and fusion rates. We show cases of dynamic motion for D-atom, D_2 molecule, D_2^+ ion, D_3^+ ion, 4D/TSC, and $6D^{2-}$/OSC. Among these, only 4D(or H)/TSC can make ultimate condensation to very small charge neutral entity with 10-20 fm diameter.

This paper also reviews a chronicle of our research papers in 1989-2007.

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GAS AND HEAT BALANCE DURING PLASMA ELECTROLYSIS

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In 1994, S. K. Sengupta reported that excess gas which exceeded the gas generation calculated form Faraday`s law was produced during an electrolysis with plasma.[1) In addition, Mizno reported that not only gas but also excess heat was produced during the electrolysis with plasma.[2,3) These reports suggest a new method for the production of hydrogen and energy. However, the reproducibility was not sufficient, and an explanation of the phenomena was required. In this study, we estimated accurate excess heat and gas by using a flow calorimetry.

K_2CO_3 light water solution was used as an electrolyte, and an anode was a platinum mesh (99.99% purity, 55meshs) with 2cm diameter of a cylindrical shape. A cathode was a tungsten rod (Φ1.0mm, 99.95% purity) and placed at the center of the cylindrical anode. The electrolysis was conducted at a constant voltage of 90 V and a flow rate of the electrolyte was fixed between at 571~831cm^3 min^{-1}. The temperature difference between the inlet and the outlet of the electrolyte was measured by Pt resistance thermometers. Mixed gas of Hydrogen and oxygen which were generated during electrolysis was collected in a reservoir and measured the rate of the gas generation by a gas flowmeter. The concentration of the electrolyte was changed from 0.2M to 0.5M.

Figure1 shows the dependence of heat balance on the concentration of electrolyte. We have not observed a clean excess heat over 10% of the inlet power, although there will be some possibility of small excess heat. Figure2 shows the dependence of gas balance on the concentration of electrolyte. The gas balance during a plasma electrolysis always exceeded that of non-plasma electrolysis.

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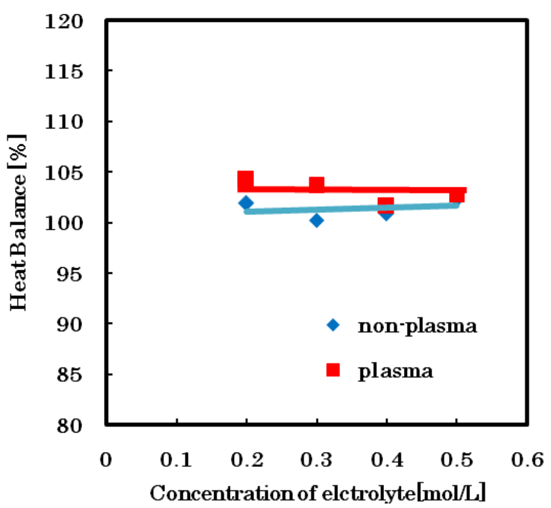

Fig 1. Dependence of heat balance on concentration of K_2CO_3 at 90V

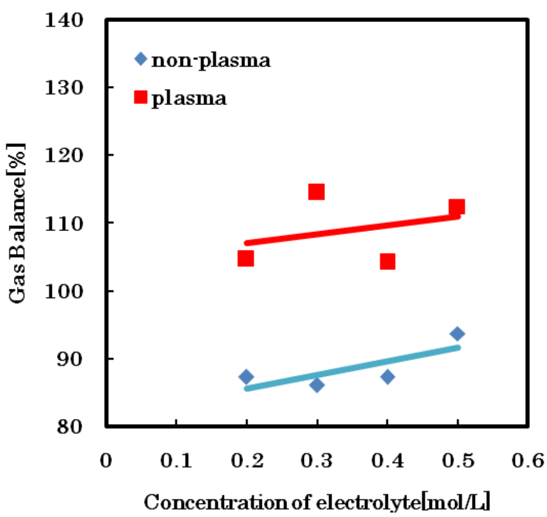

Fig 2. Dependence of gas balance on concentration of K_2CO_3 at 90V

Investigation of Nuclear Transmutation in $(CaO/Sr/Pd)_n/CaO/Sr/Pd$ Samples

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It has been claimed that forced permeation of D through Cs-doposited Pd/(CaO+Pd)/Pd samples induced nuclear transmutations from ^{133}Cs to ^{141}Pr, from ^{88}Sr to ^{96}Mo, from ^{138}Ba to ^{150}Sm and from ^{137}Ba to ^{149}Sm **[1]**. To confirm the nuclear transmutation and to elucidate the mechanism, we have constructed an experimental system, with which accelerator analyses including PIXE, ERDA, NRA and RBS can be made *in situ* and simultaneously with gas permeation through the samples. Results of the first several experimental runs are reported in the present paper.

The samples were prepared by means of sputtering deposition of CaO and Pd layers with a thickness of 8 nm and 18 - 54 nm, respectively, in addition to electrochemical deposition of Sr on the Pd bulk with a thickness of 0.1 mm. The common feature of the sample is expressed as $Vacuum/(CaO/Sr/Pd)_n/CaO/Sr/Pd/D_2$ except for the sample 4 having no CaO layer. The film was mounted on a vacuum flange with O-ring seal and the rear surface was exposed to D_2 gas at a pressure of 0.1 MPa typically for 7 - 48 days. The D flow rate through the complex sample was 0.01 – 0.15 sccm. We performed *in situ* analyses for characterization of the sample before, during and after D permeation; 3-MeV-p PIXE for elemental analysis, 2.5-MeV-^{3}He NRA or 4-MeV-^{4}He ERDA for D distribution analysis. For monitoring the incident particle fluence RBS was applied simultaneously.

The results of the PIXE analyses are summarized briefly below. As reported in ref.[2], we had a reasonable evidence for nuclear transmutation from Sr to Mo, which is shown as Run 1 in the table. We have intended to increase the amount of the elements involved in the present work.

In Run 4, an increase (4.6×10^{14} cm^{-2}) in the Mo areal density to compensate a decrease (5.7×10^{14} cm^{-2}) in the Sr areal density was observed until after 120-hour permeation. After leaving the system in the D flow for 1.8 week, however, both areal densities returned to the initial ones before permeation. In Run 5, monotonic decrease in the areal densities of Sr and Mo was observed. So we tried to replicate Run 1. Up to the present, we have not confirmed occurrence of the nuclear transmutation.

Table 1. Summary of the sample structure and the results.

Run No.	Sample structure	Areal density [10^{15} cm^{-2}] Before permeation		Elapsed time [h]	D fluence [10^{21} /cm^{-2}]	Areal density [10^{15} cm^{-2}] After permeation	
		Sr	Mo			Sr	Mo
1	$Vacuum/CaO/Sr/Pd/D_2$	0.13	0	242	0.6	0.09	0.07
4	$Vacuum/(Sr/Pd)_9/Sr/Pd/D_2$	3.7	2.4	422	33.3	3.7	2.0
5	$Vacuum/(CaO/Sr/Pd)_9/CaO/Sr/Pd/D_2$	30	2.9	280	13.0	29	2.3
6	$Vacuum/CaO/Sr/Pd/D_2$	2.6	5.0	1173	211	2.6	4.7
7	$Vacuum/CaO/Sr/Pd/D_2$	21.2	1.3	615	16.4	15.3	1.1
8	$Vacuum/CaO/Sr/Pd/D_2$	4.6	1.2	474	16.3	3.8	1.0

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Radiation Measurement during Gas Permeation Experiment

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Anomalous nuclear reactions have been reported in a gas loading system such as electrical discharge, gas permeation, gas desorption and so on. Since these experiments are carried out at low pressures or in a vacuum chamber, charged particles from nuclear reactions can be measured, while one cannot detect them except neutrons in an electrolysis system.

In this study, we tried to observe charged particle emissions in a gas permeation system. Normal Pd samples (Nilaco corp.) without annealing and Pd complexes (supplied from MHI and Toyota labs) were set as a partition between a gas chamber (1.5 atm D_2/H_2) and a vacuum chamber (10^{-5} Pa). A detector used was a Cerium doped Yttrium Aluminium Perovskite ($YAlO_3$) scintillator (YAP(Ce)), which shows good chemical stability and little dependence of light yield on the temperature. The YAP(Ce) was placed at 10 – 15 mm from the sample in the gas chamber and the scintillation light was transmitted through a quarts light guide to a photomultiplier tube set at outside of the chamber. Plastic scintillators placed below the chamber served as veto counters to reject cosmic-ray events.

For high reliability we applied pulse shape discrimination (PSD) technique to identify very rare events. All pulse shapes from the photomultiplier tube were recorded by a digital storage oscilloscope with a sampling ratio of 1250 points / 500 nsec. After the rejection of the cosmic-ray events, all pulses are analyzed to identify particle energy.

Fig.1 shows normal pulses of 5.5 MeV α particles from ^{241}Am checking source. A decay time of the scintillation is about 25 nsec which agrees with those reported by several groups. Fig.2 shows examples of anomalous pulses detected during the experiment. Pulse heights are anomalously large and their decay times are quite small, while those of cosmic rays are, of course, about 25 nsec. If these events were originated from scintillation, the decay time should be constant. Therefore we consider that these pulses are the result of burst light emissions that pass through the scintillator without an interaction and directly reach the photomultiplier tube. These anomalous pulses are rarely detected through the long term gas permeation experiment.

At the conference, we will present PSD analysis techniques and detail of these anomalies.

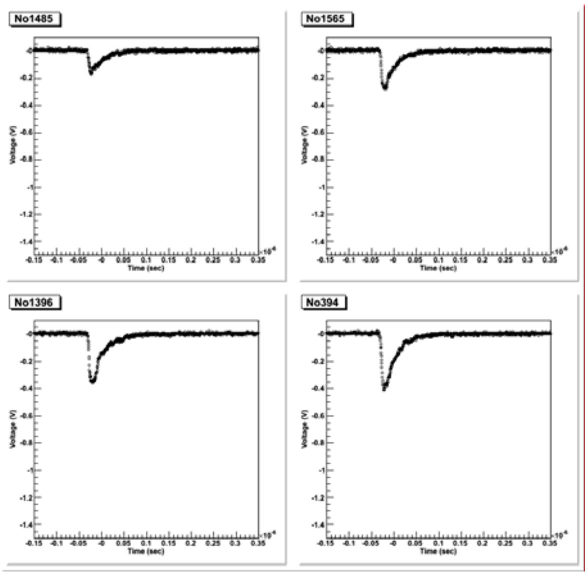

Fig. 1 Pulse shapes of 5.5MeV α particles from ^{241}Am checking source.

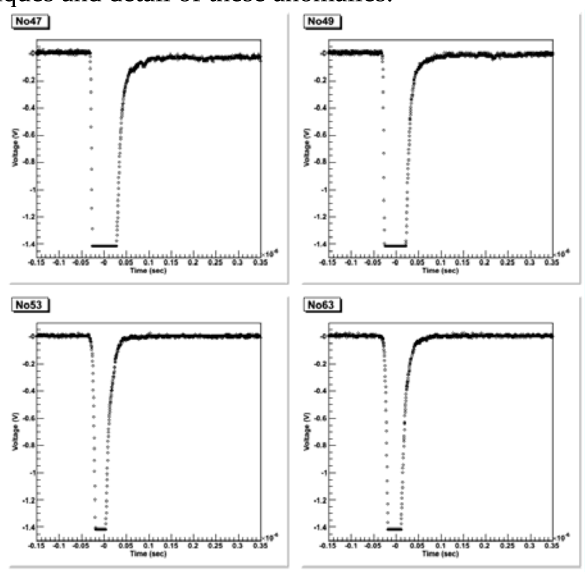

Fig. 2 Anomalous pulse shapes observed during gas permeation experiment.

Producing Elements of Mass Number 137 and 141 by Deuterium Permeation on Multi-layered Pd Samples with Cs deposition

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Deuterium and hydrogen permeation experiments have an advantage of minimizing contamination to the palladium sample, which is preferably used in investigating small amount of elements. We have observed an anomalous count peak at mass number 137 by a deuterium permeation experiment [1, 2]. In this present investigation, we prepared two types of multi-layered Pd samples. The first one consisted of a couple of CaO and Pd thin films on a base Pd foil of 0.1x12.5x12.5 mm in size. The next one had five couples of similar CaO and Pd thin films on the same size of Pd foil. Both samples had small amount of Cs on these uppermost surfaces. Elemental analysis on the Pd samples was performed after deuterium permeation experiment and for control Pd samples using TOF-SIMS.

The TOF-SIMS has provided the marked count peaks at specific mass numbers in spectra after deuterium permeation at 70℃, only when the multilayered Pd sample with a small amount of Cs was used. The marked peak at mass number 137 has been observed for both types of sample. Furthermore, a small count peak was seen at mass number 141 for both types of sample. The substance with mass number 137 and 141 could be ^{137}La and ^{141}Pr, respectively. The substance with mass number 137 might be ^{137}Ba. These elements would be produced during deuterium permeation by some nuclear transmutation occurring on/in the uppermost of multi-layered Pd sample. The results suggest that both samples, consisting of CaO/Pd thin films on Pd foil, contribute to induce production of such elements. This would imply a transmutation of 4 mass number increasing before ^{141}Pr production [3].

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Effect on the energy level of a hydrogen atom due to magnetic moment interaction

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An attractive model to explain cold fusion phenomena was proposed by Vigier and was developed by Samsonenko *et al.* They numerically obtained a new quantum level (a few keV) of a hydrogen atom. They solved Schrödinger's equation for two-body sysytem (a proton and an electron) under the influence of magnetic interactions between them. The lowest energy state was not mentioned in the paper, because its value probably came to relativistic regime. Therefore, we formulate this model by Dirac equation and investigate an effect on energy levels due to magnetic interaction.

Numerical simulation of vortex pattern appeared on electrode surface after long term electrolysis of well annealed thick Pd rod in 0.1M LiOD

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During long term electrolysis for well annealed thick Pd rod (9.0 mmϕ) in 0.1M LiOD vortex patterns were observed [1-2]. The morphology of the postelectrolysis electrodes revealed that there were appeared two long faults but without any cracking on the surface. This vortex pattern was proved that the hypothetical particles mass flow coincidently through the electrode surface/electrolyte interface using Lattice Gas Cellular Automata numerical simulation method [3], however there still remained ambiguous with respect to the nature of energy of moving particles. Our interest is focused on analyzing the mechanism of the peculiarities observed during cold fusion experiments.

In this paper recent progress of the phenomenological approach using computer simulation will be presented as the followings.

· Since previous studies had been limited by the choice of computer resources, a little more convenient PC is adopted to improve the speed of computation, e.g., change of platform from Windows to Linux etc.

· Optimum B.C. for simulating vortex patterns emerging in the 2D idealized fluid flow

· Escaping D_2 from Deuterized Pd surface (CFD method)

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Evolution of Co-operative tunnel resonance in Canonical Ensemble system

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Various cold fusion phenomena have been observed, where hydrogen isotopes are loaded in Pd metal by electrolysis or electrical discharge in gaseous plasmas. The nuclear transformation was elucidated by the D_2 gas permeation method through Pd/CaO multi-layered Pd film. In these experiments the flow of deuterium gas and charged particles involving electrons or protons through the particular matrixes has a key to solve the multiply folded phenomena.

In this paper a fluid is composed of identical particles, which move randomly under usual statistical mechanics and coincidently termed as tunnel resonance process.

According to tunnel resonance theory proposed by Ban [1-2], penetration of the fluid is performed in a coincidental mode through Pd lattice (Pd/CaO interface) forming the multi-barrier, whereas the particles behave like the perfect fluid [3].

Moreover, the fluid composed of identical particles can be assumed to be Canonical ensemble system taking into account a thermal equilibrium between that and an external heat bath.

By the way, it is natural to suppose the motions of the Canonical ensemble system and the co-operative tunneling process assume two opposite behaviors: random and coincidental, although it is possible to discuss the cold fusion related phenomena as follows. In some instance the particles motion is controlled by random process and next the experimental system behaves instantly like the perfect fluid; particles move coincidently obeying mass and momentum conservation rules. This situation resembles to alternative appearances of a side at coin toss performances.

It is known that a usual tunnel current emerges due to incoherent electron transfer in a electronic device, however, in cold fusion phenomena the co-existence two motions controlling the dynamics appears resonance mode in the tunneling process.

Theoretical consideration

Given momentum p and space position q in many particles system, a state variable is expressed as

$$\Gamma = (p_1,\ q_1,\ \cdots\cdots\cdots\cdots)$$

If we assume that the given state of the Boltzmann distribution Γ_0 is embedded into the state Γ assuming the other state $\Gamma_\perp$, that is Γ_0 is a state variable of a partial system in that of Γ

$$\Gamma = \Gamma_0 \otimes \Gamma_\perp$$

The energy function $H(\Gamma)$ of the state Γ is shown using Hamiltonian of the Boltzmann distribution $H_0(\Gamma_0)$

$$H(\Gamma) = H_0(\Gamma_0) + H_\perp(\Gamma_\perp)$$

Here, the distribution function $f(\Gamma)$ is expressed as the products applying the method using separation of variables

$$f(\Gamma) = f_0(\Gamma_0) f_\perp(\Gamma_\perp)$$

where $f_0(\Gamma_0) = Z_0^{-1} \exp(-\beta H_0)$ is given and β is temperature.

We finally obtain $H_\perp(\zeta)$ as the solution of the above Eq.

$$H_\perp(\zeta) = \tau^2 \zeta^2 / 2$$

where τ is an arbitrary parameter that shows relaxation time.

Thus, Nosé-Hoover equation obtained represents the particles motion.

On the other hand, the characteristic of the equation is drawn as

$$H_0 - (m+1) \ln H_0 \leqq C$$

where m is an integer and C is the constant.

The above inequality implies that an increase of degree of freedom, i.e., the addition of variable ζ loses the ergodicity of the Boltzmann distribution.

Actually the H_0 of harmonic oscillator is given

$$H_0 = p^2/2 + q^{2k}/2k \quad (k = 1, 2, \cdots)$$

This system exhibits the Taurus structure of the state in phase space diagram(p, q, ζ). The Taurus structure is known as a resonance state of many periodic oscillators. This situation corresponds to tunnel resonance of the fluid, whose constituents move periodically in coincidental mode.

When the experimental system exhibits the peculiarities of cold fusion, tunnel resonance of the fluid proceeds accompanied with an increase of one degree of freedom(energy) resulting the Taurus structure of the state in phase space diagram.

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The Pythagorean theorem and nuclear fusion in Platonic structures

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Lorentz-Fitzgerald contractions have been evident as an experimental reality, but the theory behind them is complex, and just as Einstein explained incomprehensible Lorentz-Fitzgerald contractions by means of the principle of the constant speed of light and the Pythagorean theorem, the author, despite the indubitable experimental reality of fusion due to condensation of deuterons in metal, has attempted to elucidate a theory of baffling condensation nuclear fusion by means of Coulomb's law, the Platonic structure of the atomic nucleus, and the Pythagorean theorem.
As shown in Equation 1 below, Coulomb's law is formulated with electric charges and distance as the main factors.

$F = q_1 q_2 / 4\pi\varepsilon r^2$, where q_1 and q_2 are electric charge 1

Accordingly, the Coulomb attraction acting between a deuteron and an electron of differing mass is equivalent to the Coulomb repulsion acting between deuterons. However, the Coulomb force differs according to distance r, and because this r is found in the numerator of the fraction, the Coulomb force increases as distance r decreases. This is the source of the difficulty posed by the barrier due to .
However, as with Coulomb repulsion, Coulomb attraction also increases as distance r decreases, and so for Coulomb repulsion in domains where r is extremely small, it should be possible to use Coulomb attraction to resolve the difficulty of the Coulomb barrier.
That is to say, when q1 is taken to be a positively charged deuteron (+d) and q2 is taken to be a negatively charged electron (-e), their charges are the same +1 and -1, yielding this:

$(F =) \mid dd/4\pi\varepsilon r^2 \mid = \mid de/4\pi\varepsilon r^2 \mid$ 2

Repulsion Attraction

It therefore follows that r is found in the numerator of the fraction in these two equations for both attraction and repulsion, and so F becomes smaller as distance increases and becomes larger as distance decreases.
Heretofore, nuclear fusion has ignored the principle in these two equations, and has merely been existing in the black hole of thought oriented toward how to cause fusion between the d and d on which Coulomb repulsion acts. This is because of the serious deficiency of ignoring that the electron, which has a mass that is an order of magnitude smaller than the deuteron, has an equivalent charge.
In this regard, the author has verified that nuclear fusion due to deuteron condensation by a combination of Coulomb attraction and repulsion making use of the action of negatively charged electrons is 100% possible.

Proc. JCF8 (Kyoto, Japan, Nov. 29 – 30, 2007)

The Cold Fusion Phenomenon as a Complexity (2)
– Parameters Characterizing the System where occurs the CFP –

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http://www.geocities.jp/hjrfq930/

Abstract

The cold fusion phenomenon (CFP) was investigated from the point of view developed in nonlinear dynamics. It was shown that the recursion relations investigated in the nonlinear dynamics are applicable to events in the CFP to explain their characteristics using the density n_n of the trapped neutrons in the TNCF model as a parameter of the recursion function.

The recursion relations

$x_{n+1} = \lambda f(x_n)$,

with a parameter λ and recursion functions $f(x_n)$ having a specific characteristic shown in Fig.1 are extensively investigated in nonlinear dynamics.

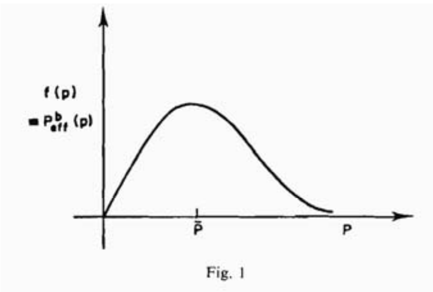

Fig. 1 Dependence of $f(p) = p\ b_{eff}(p)$ on p after Feigenbaum

The well known logistic difference equations (l.d.e.)

$x_{n+1} = \lambda\ x_n\ (1 - x_n)$

are its simple forms and their behavior for a change of the parameter λ is investigated to the last detail (Fig.2).

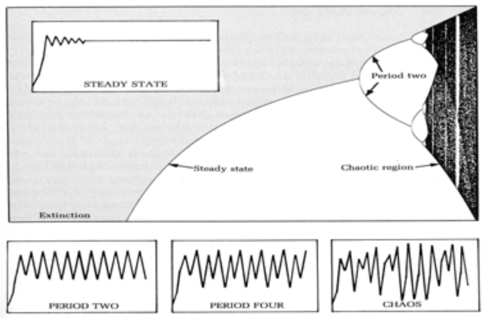

Fig. 2 Bifurcation diagram to show period-doubling and chaos (From “Chaos” by J. Gleick. p.71).

One of the extensive data sets obtained in the CFP is the data of neutron emission by De Ninno et al. published in 1989. In their data, there are two runs showing characteristic behaviors of the emission; their similarities to Fig. 1 and Fig. 2 suggest strongly complexity of the CFP.

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The Cold Fusion Phenomenon as a Complexity (3)
– Characteristics of the Complexity in the CFP –

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Abstract

Complexity in the cold fusion phenomenon is investigated using typical experimental data sets and its characteristics are determined. It is shown that the density n_n of the trapped neutrons (quasi-free neutrons in CF materials) assumed in the TNCF model is usable as the parameter of recursion relations in the nonlinear dynamics in which the bifurcation and the chaotic behavior are mathematically investigated extensively. Thus, the CFP has to be investigated taking the nonlinear dynamical point of view into consideration.

The data sets used are 1) De Ninno et al., 2) McKubre et al. (Fig. 1) and 3) Dash et al. (Fig. 2).

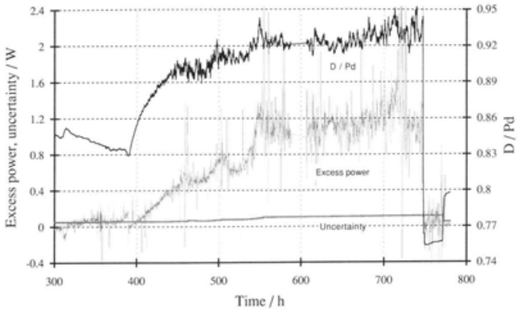

Fig. 1 Variation of Excess Power, Uncertainty and Loading ratio (McKubre et al. (1993) Fig. 5)

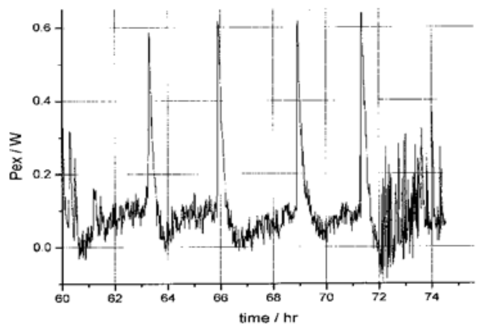

Fig. 2. Excess power pulses during a 14 hour period of an experiment (070108) which lasted 12 days (Dash et al.)

Figs. 1 and 2 show temporal variations of excess power generation observed by the authors denoted. In addition to the data sets by De Ninno et al. analyzed in the previous paper (Complexity (2) in this issue), we show correspondence of experimental data sets to the recursion relations thus providing a cornerstone for the science of the CFP.